
The development of digital libraries in Taiwan

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Abstract

At the opening of the twenty-first century, developments of digital libraries have been attracting the attention of many countries and Taiwan is no exception. The purpose of this article lies in delineating recent developments of digital libraries in Taiwan. This article first quotes a definition of a digital library, and based on this definition, an overview of some of the digital library programs in Taiwan is presented. These programs are divided into four categories: preservation of Chinese and Taiwanese culture; establishment of domestic research digital libraries; provision of foreign research digital libraries and integration of conventional and digital libraries.

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1 Introduction

The rapid development of information and telecommunication technologies, especially the emergence of the Internet and WWW, is gradually innovating every facet of human life. As to why the Internet is so popular, we think that the content appearing on the Internet is an essential factor. After all, it is valuable and quality content that makes the Internet meaningful and go deeper and deeper into human life. Among the diversity of Internet content, the digital library (DL) plays an important role in the acquisition and dissemination of information.

Taiwan, one of the four small dragons in the Asia-Pacific region, started her National Information Infrastructure (NII) Program in 1994 (Kuo, 1999). At the present stage, the achievements of Taiwan's NII Program include:

- (1) All primary and middle schools, as well as universities, have connected to Internet.
- (2) The Internet population has rapidly exceeded 4 million, and is one of the highest ratios in the Asia-Pacific region.
- (3) Internet applications, like long-distance learning, the digital library, electronic commerce, and electronic government have been developing vigorously.

Introducing quality content into the Internet and leveraging the Internet as a channel for accelerating the dissemination and sharing of academic research are among the primary goals of Taiwan's NII Program. Establishing digital libraries with cultural-, educational-, or research-oriented content is obviously an effective strategy for achieving the goals. In consequence, quite a large number of activities regarding digital libraries are being undertaken in Taiwan.

So, what is a digital library? In the literature, there are many definitions of the term. In this article, we choose to use a seemingly most logical definition from the viewpoint of librarians, which was proposed by the American Digital Library Federation (1998):

Digital libraries are organizations that provide the resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities.

Based on the above definition, Cleveland (1998) gave some of its characteristics. One of these characteristics is:

Digital libraries are the digital face of traditional libraries and *include both electronic (digital) as well as print and other (e.g. film, sound) materials.*

Cleveland (1998) also thought that:

In reality, digital libraries will not be a single, complete digital system that allows users to promptly access all information, for all disciplines, from anywhere around the world. Instead, they will most likely be *a collection of disparate resources and disparate systems*, catering to specific communities and user groups, created for specific purposes. They also will include, perhaps indefinitely, *paper-based collections.*

Given the above definition and characteristics of a digital library, this article delineates several remarkable activities of digital libraries in Taiwan. These activities are roughly classified into four categories and will be elaborated in sequence:

- (1) preservation of Chinese and Taiwanese culture;
- (2) establishment of domestic research digital libraries;
- (3) provision of foreign research digital libraries;
- (4) integration of conventional and digital libraries.

2 Preservation of Chinese and Taiwanese cultures

Preserving cultural objects in their digital format has aroused international attention. The advantages are manifold. First, cultural objects have their physical lifespan. Frequent exhibitions and unfavorable preservation environments may even shorten the lifespan. If digital surrogates, instead of physical objects, are used for exhibitions, the chance of damage can be reduced. Second, benefiting from Internet and DL techniques, cultural objects can be introduced to the public beyond the limitation of time and space. It is expected that with the power of the Internet, people may cherish the value and beauty of culture more than ever.

Several endeavors to create cultural-related digital libraries (we often call this kind of digital library a “digital museum”) are ongoing in Taiwan. In this section, we present two of these efforts:

- (1) National Palace Digital Museum; and
- (2) NSC Digital Museum Program.

National Palace Digital Museum

The National Palace Museum (NPM)[1] is internationally well-known for its tremendous and splendid collection of Chinese treasures. The scope of NPM’s collection comprises representative art works from every stage in the history of Chinese civilization from the early Neolithic Age (about 10,000 to 5,000 BC) to nowadays. The material types of the collection include ceramics, jades, bronzes, miscellaneous artefacts (such as studio items, lacquer wares, enamels, carvings, costumes, and curios), painting and calligraphy (including tablet rubbings, embroideries, tapestries, and fans), rare books, and historical documents. The number of *objet d’art* in the NPM total around 700,000.

Among the NPM collection, three kinds of popular art works are chosen first as the contents of the NPM Digital Museum (NPDM) (Tsai, 1999). They are:

- (1) enamels from the Ming and Ch’ing dynasties;
- (2) the Famous Album Leaves of the Sung dynasty; and
- (3) Buddhist scriptures and related drawings.

The enamels from the Ming and Ch’ing dynasties digital museum show precious enamel wares from the Ming and Ch’ing periods. In addition, the characteristic, origins, production methods, and differences of various kinds of enamels are also presented for education and research.

The Sung dynasty was a golden epoch in the history of Chinese calligraphy and painting, and NPM collects considerable quantities of these kinds of art works from this dynasty. The purpose of the Famous Album Leaves of the Sung Dynasty digital museum lies in exhibiting the marvelous accomplishment of calligraphy and painting of the Sung period.

Buddhism is one of the most prevalent religions in Taiwan. NPM has gathered about 400 volumes of Chinese scriptures and 154 leaves of Manchurian and Tibetan *sutras* since the Sung dynasty. The Buddhist Scriptures and Related Drawings digital museum offers the public a deeper understanding about Buddhism by showing related illustration in NPM’s collection and from other domestic and international institutions.

In addition to exhibiting a large amount of digitized art works, most of which are Joint Picture Expert Group (JPEG) images, several techniques are integrated into NPDM. For instance, a powerful query system is provided for users to discover digitized art works efficiently and effectively. Visible and invisible watermarks are attached to online images for protecting intellectual property rights. Furthermore, virtual reality enables users to browse, rotate and move digitized art works in three dimension.

With the uniqueness of NPM's collection, since January 2000 NPDM has been selected as one theme project of the NSC Digital Museum Program, which is described in the next sub-section; moreover, NPM will also participate in the National Digital Archive Program, which is a national level program attempting to digitize and archive cultural and historical relics and is foreseen starting from the year 2001.

NSC Digital Museum Program

The NSC Digital Museum Program[2], started in July 1998, is an inter-organizational program for establishing digital museums with Taiwanese and Chinese cultural content. The program is supported and subsidized by the National Science Council (NSC) of the Taiwan government. Before the program, a few disparate digital museums had actually been created, like NPDM introduced previously. The program tries to integrate all these separate endeavors and facilitate the sharing of techniques and experiences of building digital museums. There are three goals to be achieved by the program (Chang, 1999):

- (1) it expects to arouse the public's attention in creating delicate Internet content;
- (2) it seeks to enable cooperation of various disciplines essential for creating digital museums;
- (3) it emphasizes experience sharing and development of key technologies in multimedia and library/information science.

The program adopts several approaches to realize the above goals. First, a number of theme projects covering multiple categories are picked out and funded. The criteria for choosing theme projects include content depth and richness, technical strength, educational value of content and level of

interdisciplinary cooperation. To encourage interdisciplinary cooperation, the working groups of each theme project should at least consist of three groups of professionals:

- (1) subject experts of the theme project's content;
- (2) computer and multimedia technologists; and
- (3) scientists of library and information organization.

Table I outlines the first year's theme projects. They cover categories from Taiwanese culture, Taiwanese natural objects and Chinese tradition. In the second year, more theme projects have been chosen and are ongoing. The second year's theme projects encompass categories from religion, life science, Chinese medicine, and Taiwanese folk artists, as well as the aforementioned categories, as indicated in Table II.

For the purpose of developing common technologies and sharing them with theme projects, the program funds a few supporting technology projects. The topics of supporting technology projects comprise culture and natural resource atlas (or GIS), literary network, standards and toolkits for metadata and query, user behavior review and analysis, information and multimedia, and watermark.

The program also holds seminars, training courses, and conferences for popularizing the concepts, techniques, and education of digital museums. In addition, newsletters are published periodically to publicize related information.

Future perspectives

In addition to NPM and the institutions participating in the NSC Digital Museum Program, many other museums, libraries, and research organizations in Taiwan have long preserved a considerable amount of precious cultural and historical treasures worth digitalizing and presenting on the Internet. To transform these treasures into their digitalized counterparts, a national-level program with larger vision and administrative authority than the NSC Digital Museum Program is required. Recently, such a program named National Digital Archive has been recommended by a strategic review board (SRB) meeting on information, electronics, and telecommunication of the Executive Yuan, and is anticipated to start

Table I The first year's theme projects of the NSC Digital Museum Program

Category	Theme project	Main organization	URL
Taiwanese culture	Tracing the Tamsui River	National Taiwan University	http://mars.csie.ntu.edu.tw/tamsui/
	Taiwanese Aboriginal	Academia Sinica	http://www.sinica.edu.tw/~pingpu/
Taiwanese natural objects	Taiwan: the Butterfly Kingdom	National Chi-Nan University	http://digimuse.nmns.edu.tw/
	Taiwanese fish	Academia Sinica	http://fishdb.sinica.edu.tw/~fishdmp/
	Taiwanese plants	Academia Sinica	http://www.sinica.edu.tw/~hastwww
Chinese tradition	Treasures from Han dynasty tombs	Academia Sinica	http://www.sinica.edu.tw/~hantomb/
	Firearms in the Ming and Ching dynasties	National Tsing-Hua University	http://vm.nthu.edu.tw/digi.museum/
	Philosophy and literature	Academia Sinica	http://www.dmpo.sinica.edu.tw/~words

Table II The second year's new theme projects of the NSC Digital Museum Program

Category	Theme project	Main organization
Chinese culture	National Palace Digital Museum	National Palace Museum
Religion	The world of Xuan Zang and Silk Road	National Taiwan University
Taiwanese folk artists	The Yu Yu Yang Digital Museum	National Chaio-Tung University
Taiwanese culture	The history of Taiwanese buildings	I-Sou University
Life science	The magic of the human body	Taipei Medical College
Chinese medicine	Chinese medicine, acupuncture and moxibustion	Chinese Medical College
Taiwanese culture and natural objects	Creatures and cultures of the Lan Yu Island	National Chi-Nan University

from 2001. Several national museums, libraries, and research organizations are proposed to participate in the program, including the Academia Sinica, National Central Library, National History Museum, National Museum of Natural Science, and so on.

3 Establishment of domestic research digital libraries

Scholars and scientists need to acquire up-to-date information to advance their research. From the mid-1990s, the World Wide Web (WWW) has offered many opportunities for scholars and scientists to rapidly obtain and exchange related information on their research. Especially, the proliferation of WWW-based reference databases and electronic journals is revolutionizing the way scholars and scientists communicate their research results.

In this article, we introduce two kinds of developments that offer research digital libraries to scholars and scientists in Taiwan. The first kind creates digital libraries with domestic research content; the second kind brings in digital libraries with international research content. We shall describe them in this and the next sections respectively.

This section focuses on the endeavors of two governmental information centers to

create local research digital libraries. The two centers are the Science and Technology Center (STIC) and National Central Library (NCL).

Science and Technology Information Center (STIC)

Established in 1974, STIC[3], under the jurisdiction of National Science Council (NSC), aims to enhance scientific and technical research and development in the Republic of China (ROC). Over the past 25 years, STIC has been assisting scientific and technical research and development by offering access to a great diversity of domestic and international information resources. In the era of digital library, the STIC has adjusted its policy to better meet the requirements of the research and education community. At the present stage, STIC's missions regarding the digital library include:

- (1) developing digital libraries with domestic information resources (described in this section);
- (2) bringing in the most useful foreign academic and research digital libraries (described in the next section); and
- (3) establishing a national interlibrary loan system to improve the quality and efficiency of document delivery service (described in section 5).

STICNET, STIC's first online database system, made its debut in 1988. STICNET

was a proprietary online service system and offered users the ability to retrieve bibliographic and directory information from 13 databases seven STIC-developed and six foreign leased. In 1997, STIC replaced the old STICNET by a new Web-based system that leverages the most advanced DL-technology. Presently, the new STICNET comprises data contained in 30+ databases, five of them are international scientific and technical databases leased from abroad and others are domestic databases, mostly developed by STIC. The domestic databases in STICNET can be classified into two classes:

- (1) bibliographic databases; and
- (2) catalog databases.

- *Bibliographic databases.* There are, in total, 12 bibliographic databases. The most important ones are Abstracts of Research Projects of the Republic of China (ROC) (1986-), Abstracts of Research Reports of ROC (1970-), Abstracts of Journal Articles of the ROC (1988-), Abstracts of the NSC-Awarded Research Papers (1985-1996/07), Abstracts of the NSC-Granted Research Papers Presented at International Conferences (1991-), Abstracts of Conference and Seminar Papers of the ROC (1991-), and Abstracts of Doctorate Dissertations and Index of Master Theses in the ROC (1987-1995/02).
- *Catalog databases.* Several union catalogs are compiled into STICNET, including union catalogs of non-Chinese scientific and technical journals available in the ROC, scientific and technical books available in the ROC, scientific instruments and equipment of the ROC, Chinese scientific and technical periodicals in the ROC, and scientific and technical periodicals in the mainland China, and so on.

STICNET has an English version, STICNET-E. Research papers of the ROC (1988-) and R&D institutions in the ROC constitute the contents of STICNET-E. The former includes articles with English bibliographic information from three partly bilingual databases built by STIC: conference papers of the ROC, research reports of the ROC and scientific and technical journal

articles of the ROC. The latter is a sketch of R&D institutions in Taiwan.

Furthermore, STIC has developed a Web-based system called Government Research Bulletin (GRB) that contains all research reports of government-funded researches. Regarding the NSCROC electronic journals, it is an electronic journal archive that currently preserves the electronic version of six NSC-published academic journals.

National Central Library (NCL)

The NCL[4] is the sole national library of the ROC. The missions of NCL are to assist academic research, sponsor cultural and educational activities and promote the professional development of librarianship in all of Taiwan's libraries. To fulfill her missions, NCL gathers abundant collections, including Chinese rare books, ROC government publications, contemporary Chinese and Taiwanese books and periodicals, Sinology studies materials, ROC doctorate dissertations and master theses, and so on.

NCL ushers in the digital millennium with its WWW-based "Remote Electronic Access/Delivery of Document Services" (READncl). Opened in February 1998, READncl offers end-users the ability to retrieve information (index and full-text) about the rich collection of NCL via the Internet. Equipped with an e-commerce mechanism, READncl allows users to read full text directly on screen, or delivered via copy, fax, or e-mail. To accommodate interlibrary loan (ILL), an online document delivery service is available for ILL representatives of all Taiwan's libraries to request and fetch full text directly online (Sung, 1999).

READncl comprises more than nine systems with over 1.5 million entries, nearly 5 million pages of text images, and also links to over 22,000 articles via the WWW. Its contents encompass the following types:

- books;
- periodicals;
- dissertations and theses;
- government information;
- singular documents;
- contemporary art and literature, etc.

and keep on increasing daily.

Designated by the Ministry of Education (MOE) as a depository library of the ROC

theses and dissertations, NCL has developed an online system for accessing bibliographic information of the ROC theses and dissertations, which is also a part of READncl. Graduate students are obligated to enter the bibliographic information of their theses and dissertations to the system. From the year 2000, NCL has started a new program similar to the Networked Digital Library of Theses and Dissertations (NDLTD)[5]. In this program, graduate students are encouraged (not enforced) to submit their theses and dissertations electronically.

As well as NCL's digitalized collection, NCL cooperates with professional groups and academic organizations in creating digitalized content in specific disciplines. The "Tang-Sung Literary Studies" is such an example. Co-conducted by NCL and Yuan-Chi University from 1997, this study intends to enhance exchange of research results and shared network resources. A digital library is established to gather full-text Tang poems and prose (about 35 million words), Sung poems and prose (about 31 million words), and the bibliographic data on related research published since 1970.

4 Provision of foreign research digital libraries

In this section, we focus on a government-supported library consortium named CONCERT that makes digital libraries with international research content available to the research and academic community in Taiwan. Before we elaborate on this consortium, we will briefly describe an experimental project conducted by the National Chiao-Tung University (NCTU), many valuable experiences of which have been transferred to CONCERT. For clarity, all the terms "WWW-based reference databases and electronic journals", "WWW-based electronic resources", or just "electronic resources" are used interchangeably in this section to denote digital libraries with international research content.

Background

National Chiao-Tung University (NCTU) is a forerunner in Taiwanese universities that provide WWW-based electronic resources for

faculties and students. In 1995, NCTU executed an experimental project named InfoSpring (Ke and Chang, 1999a; Ke *et al.*, 2000) for offering her patrons the service of WWW-based electronic resources. Mirror sites of several electronic resources were installed locally in NCTU for overcoming slow connection speed to original sites, mostly located in the USA. The mirror sites installed included IDS from CSA, SDOS from Elsevier, Ei Compendex Web from Ei, SCI and SSCI from ISI, and over 20 databases from OVID. These mirror sites were shared among other academic subscribers in Taiwan with permission from publishers, under consideration for resource sharing.

InfoSpring's experiences in resource sharing and mirror site management were later transferred to CONCERT in 1998.

Several issues were raised when academic libraries in Taiwan attempted providing electronic resources for their patrons, including:

- (1) expensive subscription fees;
- (2) complicated licensing agreements; and
- (3) scarce technical staff for solving network- and computer-related problems.

Because the above issues could not be solved by any single library, academic libraries in Taiwan started thinking about the possibility to establish a consortium to tackle them.

In September 1998, a library consortium with a goal to bring in electronic resources cost-effectively was established. This consortium is named Consortium On Core Electronic Resources in Taiwan (CONCERT) (Ke *et al.*, 1999a)[6].

Attempting to achieve its goal, CONCERT adopts the following strategies:

- (1) Implement a resource sharing policy by integrating national resources, including funding, manpower, hardware and software, and technical knowledge.
- (2) Assist members to improve network infrastructure, including the provision of local servers for building mirror sites of a few databases, so that members can access available electronic resources with satisfactory connection speed.
- (3) Enable a collective purchasing mechanism in order to acquire electronic resources in a cost-effective manner.
- (4) Negotiate licensing agreements with information providers on behalf of members. In this manner, the time and

effort of each individual member spent on license negotiation and review can be saved.

- (5) Establish a long-term and stable mechanism for using foreign databases.
- (6) Catch and understand the requirements of academic research, evaluate and make available needed electronic resources promptly.

All colleges, universities, junior colleges, research institutes, and non-profit organizations in Taiwan are eligible members of CONCERT. At present, CONCERT has about 163 members. STIC and MOE are the funding and administration agencies of CONCERT. Especially, the International Resources Division of STIC is responsible for the regular operation of CONCERT.

Core program

The core program of CONCERT is to offer foreign electronic resources in a cost-effective way. Databases are chosen as "core" collections of CONCERT mainly according to the investigation of Wu (1997) and the use of statistics from several foreign databases served by STIC in these years. STIC also proactively recommends electronic resources as the core collections of CONCERT.

Up to May 2000, CONCERT made available over 60 reference databases and e-journal systems from Academic Press, Bell & Howell, CSA, EBSCO, Ei, Elsevier, Gale, Grolier, IEEE, ISI, OCLC, OVID, Springer-Verlag and Swets.

CONCERT adopts two licensing models for subscribing to electronic resources:

- (1) group purchasing; and
- (2) national-academic licensing.

For a database subscribed to by the group-purchasing model, CONCERT leverages union strength to negotiate with information providers for the best possible price and rights. Members subscribe to this kind of electronic resource according to their individual needs and pay the subscription fee mostly by their own local budget (a proportion of the subscription fee is subsidized by MOE in the year 2000).

National-academic databases are subscribed to by academic members with the funds supported by STIC and MOE. All academic members are allowed to use these databases without paying any extra money. As the national-academic licensing model is

beneficial to establish a level playing field for members' research environments, STIC and MOE prefer this strategy if pricing is affordable and reasonable.

Database access approaches

Although users can seemingly access the needed information services "any time, any place" in the global Internet era, at the present stage it is far from true because of the limited Internet bandwidth. To make effective use of the collections of CONCERT, it is very critical to offer members a speedy (at least acceptable) network connection for using these databases. Taking into consideration the Internet infrastructure in Taiwan, CONCERT adopts two kinds of database access approaches:

- (1) *Access through mirror sites installed locally in Taiwan.* In general, the Internet speed from Taiwan to information providers' original sites is not satisfactory. To tackle this problem, with the permission from and cooperation of information providers, CONCERT establishes mirror sites locally in Taiwan for databases of CSA, Ei, Elsevier, ISI, and OVID, and users access the local mirror sites instead of the original sites. In this manner, the performance is enhanced significantly. STIC purchases most of the shared central servers, storage space, and software for building mirror sites. It is also possible for a particular member willing to act as a consortium host to take charge of the installation and maintenance of databases. In this case, the consortium host will buy the necessary equipment from its own budget (the databases of CSA and Elsevier are examples). Strong technical support is very essential for successfully installing and maintaining mirror sites. NCTU now manages most mirror sites for sharing the experiences learned from the InfoSpring Project (Ke and Hwang, 1999b).
- (2) *Access through Internet.* This is the ordinary way to use databases. Members connect to the database servers installed and maintained by information providers.

The above two approaches have their pros and cons. CONCERT chooses an appropriate approach for using a specific database according to the evaluation of several factors (as shown in Table III). Please

Table III Criteria for choosing either the mirror site or Internet approach

Comparison	Mirror site	Internet
Set-up and maintenance cost	Expensive	Cheap
Connection speed	Good	Bad
Add-on values	Many	Few
Policy (IPs' and CONCERT's)	Depends	Depends

refer to an earlier article written by the authors (Ke *et al.*, 1999a) for detailed comparisons between the two approaches.

5 Integration of conventional and digital libraries

According to the definition and characteristics of a digital library given in the introduction, both electronic and paper materials co-exist in a digital library. The UK Electronic Libraries (eLib) Programme even use the term "hybrid library" to emphasize this reality (Rusbridge, 1998). For managing a hybrid library, it is a big issue to provide seamlessly integrated services that encourage patrons' resource discovery and information use, in a diversity of formats and from a number of local and remote sources.

Without doubt, in a hybrid library, interlibrary loan (ILL) and document delivery services (DDS) would continuously play an important role for assisting patrons to obtain the needed information that is not owned by the library itself. The challenge is how to bring a range of technologies and services together for creating an ILL/DDS service meeting the requirement of patrons and the librarians.

As recently as two years ago, few patrons in Taiwan could submit ILL requests electronically. Most patrons mailed or brought paper request forms to the ILL borrowing offices of their libraries, and then the borrowing offices would mail or fax the paper request forms to lenders. Most ILL lenders used fax or the Taiwan Postal Service for photocopies, rather than the newly emerging Ariel mechanism. For book delivery, most libraries used the Taiwan Postal Service. In such a circumstance, the average turnaround time of ILL requests was long. Furthermore, no national method was available to handle the process of billing and payment.

The situation has changed. STIC and NCTU started developing the Taiwan Serial Union Catalog and Interlibrary Loan

System (the ILL system) from September 1998. Its goals are to expedite the ILL process, improve the patron service, and reduce the workload of librarians by adequately utilizing the computer and network technology. Accompanying this system, an interlibrary loan service center (the ILL service center) has also been built since July 1999 to offer services and assistance to participant libraries.

System characteristics

Briefly, the functionality of the Taiwan ILL[7] system is very similar to that of the OCLC ILL system. The following elaborates on the characteristics of the Taiwan ILL system.

- (1) *WWW-based working environment and centralized database.* The system is a WWW-based system. Through the WWW, patrons and librarians can perform ILL-related actions on this system, including searching the serial union catalog, filling out online request forms, and processing interlibrary loan requests. A centralized database is built to store the serial union catalog and the information about libraries, patrons, and ILL transactions.
- (2) *Integrated serial union catalog.* The serial union catalog contains about 30,000 journal titles (foreign, Taiwanese, and mainland Chinese journals) owned by 300 or more Taiwanese libraries. Patrons can query the union catalog to identify location of serial documents they need and then issue an online ILL request.
- (3) *Patron-initiated material requests.* The system enables patron-initiated material requests by letting patrons fill out online ILL request forms. For requesting a serial document, a patron may search the serial union catalog first to find out a certain journal he/she wants to request, and then the journal title and other necessary information will be carried to the ILL request form automatically. Patrons may choose at most three lending libraries to process their requests in sequence (i.e. if a preceding library fails to fulfil a request, the request will be forwarded automatically to the succeeding library). As to book requests, currently no union catalog is built into the system; nevertheless, patrons can still write a blank request form.

In case no domestic libraries own the needed material, a patron can still issue an international ILL request by writing a blank form. The borrowing office of the corresponding library will then determine to send the request to a specific international document supplier (commercial or non-commercial).

- (4) *Library-mediated ordering.* Librarians are involved closely in processing ILL requests. For instance, an ILL request should be verified first by borrowing librarians before it is sent out to lending libraries. A request will go through a number of transaction states before it is completed (no matter success or failure), such as waiting for verification, waiting for processing, in process, waiting for picking up by patrons, request successful, request rejected, among others, and either borrowing or lending librarians are responsible for switching these states, according to the real processing status of the request.
- (5) *Traceable ILL states and statistics.* The system keeps track of the states of all ILL requests, which is beneficial for librarians and patrons to know the current processing status of requests. Furthermore, the system generates statistics regularly, including the number of requests, average turnaround time, fill rate, number of requests per journal per library, etc. Libraries can use these statistics for improving the ILL performance and establishing their collection-development policies in the long run.
- (6) *Centralized billing and payment.* The model of billing and payment for ILL transactions can be decentralized or centralized. The traditional billing and payment model is decentralized. In other words, a library has to bill every library borrowing materials from, and pay every library lending materials to, it. In this decentralized model, librarians have to spend a lot of time on the routine process of billing and payment.

OCLC's implementation of the ILL fee management (IFM) system in 1995 is the first endeavor to build a centralized billing and payment model. The Taiwan ILL system contains an ILL fee management mechanism similar to OCLC's IFM system, and the ILL

service center takes charge of the process of invoicing and payment.

Current status

STIC and NCTU launched this system (Taiwan ILL system[7]) in September 1999. The eligible libraries for using the system are the member libraries of InterLibrary Cooperation Association (ILCA) – up to now ILCA has 427 member libraries including academic, research, public, and military libraries. At present, 304 (70 percent) of ILCA libraries exploit the system for their daily ILL operation, and 241 (80 percent) of the libraries using the system participate in the process of centralized billing and payment. The 30 percent of ILCA libraries not joining the system are mostly public and military libraries, and the primary reasons for not joining the system are lack of computer/network infrastructure or security regulation for connecting to the Internet (for military libraries). Conflict with the internal accounting procedure is the major reason why a few libraries do not take part in the centralized billing and payment.

Table IV indicates some statistics calculated from November 1999 to March 2000. Obviously, the performance of using the system is becoming better and better during this period. An in-depth comparison with the performance of the times before the ILL system appears is being undertaken.

Future perspectives

The ILL system has been employed by ILCA members for only nine months. All participants regard this system as a useful tool to enhance their daily ILL operation. In order to meet the expectation of Taiwanese libraries, NCTU and STIC should keep improving system functions according to the responses of librarians and end-users. Thorough statistics should be gathered for the purpose of analyzing ILL performance and supporting the establishment of collection development policy of participating libraries.

STIC and NCTU plans to further develop this system into Taiwan's ILL/DDS portal site. The idea is to integrate all domestic ILL/DDS sources into the system, as the system has a well-controlled workflow and centralized billing and payment model. For instance, at present the ILL system lacks a book union catalog; nevertheless, NBINET developed by the National Central Library

Table IV Preliminary ILL performance measurements for the Taiwan ILL system

	November 1999	December 1999	January 2000	February 2000	March 2000
Total ILL requests	6,383	8,460	7,543	6,323	11,658
Completed rate (success and failure)	97.1%	97.4%	96.9%	96.6%	95.8%
Fill rate	81.1%	81.7%	84.1%	85.6%	85.0%
Average turnaround time (hours)	294	294	304	294	241

(NCL) is renowned as a powerful tool of cooperative cataloging and union catalog for books. If we integrate NBINET with the ILL system, NBINET can play the role of a book union catalog in the ILL system. Besides, some organizations in Taiwan have already established bibliographic databases for their collections and offered ILL/DDS. However, most of these bibliographic databases and their associated ILL/DDS are separate or just allow users to write online request forms. If we can integrate these bibliographic databases into the ILL system, users and librarians will face a unified system that conveniently requests and serves all kinds of materials.

Currently, about 30 percent of ILCA libraries do not use the ILL system for their daily ILL operation due to a variety of reasons. This situation bothers many participating libraries, as their librarians have to handle some requests in the traditional manner. The ILL service center may act as a broker in the future. In other words, all libraries not using the ILL system can send requests to the Service Center, and then the Service Center will dispatch requests to participating libraries.

The ILL system may adopt the international ILL standard (ISO 10160 and 10161) for future communication with other international ILL systems, like OCLC's ILL system. In this manner, a global ILL/DDS mechanism can be created for Taiwan libraries, and we can approach the ultimate goal of the hybrid library further.

Conclusions

This article has given an overview of some of the digital library programs currently executed in Taiwan. These programs are divided into four classifications. Regarding the preservation of Chinese and Taiwanese culture, we have described an individual organization endeavor, the National Palace Digital

Museum, and a government-supported, inter-institution program named the NSC Digital Museum Program. The NSC Digital Museum has paved the way for making a model of inter-organizational cooperation in creating digital museums, and we believe its experiences will be useful in implementing the National Digital Archive Program which will be initiated in the near future.

The digital library is a powerful tool for obtaining research information. The efforts of two governmental information centers, the Science and Technology Center (STIC) and National Central Library (NCL), to create local research digital libraries have been described together with a newly established library consortium – the Consortium On Core Electronic Resources in Taiwan (CONCERT) which aims to bring in international research digital libraries in a cost and effective manner.

Facing an era of hybrid traditional and digital libraries, libraries have to assist patrons to get all the needed information, either paper- or electronic-based. Taiwan now has implemented an interlibrary loan system to improve the ILL performance, and it is anticipated that this system will grow into an integrated ILL/DDS portal system, which in the long run will allow patrons of Taiwanese libraries to obtain all the needed information conveniently and promptly.

Notes

- 1 National Palace Museum, <http://www.npm.gov.tw>
- 2 NSC Digital Museum Program, <http://mars.csie.ntu.edu.tw/~dlm>
- 3 Science and Technology Information Center, <http://www.stic.gov.tw>
- 4 National Central Library, <http://www.ncl.edu.tw>
- 5 Networked Digital Library of Theses and Dissertations (NDLTD), <http://www.ndltd.org/index.htm>
- 6 Consortium on Core Electronic Resources in Taiwan, <http://www.stic.gov.tw/fdb>
- 7 Taiwan ILL System, <http://ill.stic.gov.tw>

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